

3/22/18

"The most difficult thing is the decision to act, the rest is merely tenacity."-Emelia Earhart

HW: "Logarithm Laws" Homework section
Test 3 on Wednesday 3/28

AIM: What are the Laws of Logarithms?

Warm Up:

1) The expression $\left(\frac{m^2}{m^{\frac{1}{3}}}\right)^{-\frac{1}{2}}$ is equivalent to

1) $-\sqrt[6]{m^5}$

2) $\frac{1}{\sqrt[6]{m^5}}$

3) $-m^5\sqrt{m}$

4) $\frac{1}{m^5\sqrt{m}}$

2) What is the inverse of the function $y = \log_3 x$?

1) $y = x^3$

2) $y = \log_x 3$

3) $y = 3^x$

4) $x = 3^y$

1. Which of the following is equivalent to $y = \log_7 x$?

(1) $y = x^7$

(3) $x = 7^y$

(2) $x = y^7$

(4) $y = x^{1/7}$

Remember, a logarithm "gives" as the y-value the exponent we must raise the base, 7, to in order to get x.

(3)

2. If the graph of $y = 6^x$ is reflected across the line $y = x$ then the resulting curve has an equation of

(1) $y = -6^x$

(3) $x = \log_6 y$

(2) $y = \log_6 x$

(4) $x = y^6$

This question is testing to see if you know that reflecting across the line $y = x$ always produces the inverse, which in this case is $y = \log_6 x$.

(2)

3. The value of $\log_5 167$ is closest to which of the following? Hint – guess and check the answers.

(1) 2.67

(3) 4.58

(2) 1.98

(4) 3.18

$5^{3.18} = 167.003... \approx 167$

(4)

4. Which of the following represents the y-intercept of the function $y = \log(x + 1000) - 8$?

(1) -8

(3) 3

(2) -5

(4) 5

$y = \log(0 + 1000) - 8 = \log(1000) - 8$
 $= \log_{10}(1000) - 8 = 3 - 8 = -5$

(2)

5. Determine the value for each of the following logarithms. (Easy)

(a) $\log_2 32$

(b) $\log_7 49$

(c) $\log_3 6561$

(d) $\log_4 1024$

$\log_2 32 = 5$

Because $2^5 = 32$

$\log_7 49 = 2$

Because $7^2 = 49$

$\log_3 6561 = 8$

Because $3^8 = 6561$

$\log_4 1024 = 5$

Because $4^5 = 1024$

6. Determine the value for each of the following logarithms. (Medium)

(a) $\log_2 \left(\frac{1}{64}\right)$

(b) $\log_3 (1)$

(c) $\log_5 \left(\frac{1}{25}\right)$

(d) $\log_7 \left(\frac{1}{343}\right)$

$\log_2 \left(\frac{1}{64}\right) = -6$

Because $2^{-6} = \frac{1}{2^6} = \frac{1}{64}$

$\log_3 (1) = 0$

Because $3^0 = 1$

$\log_5 \left(\frac{1}{25}\right) = -2$

Because $5^{-2} = \frac{1}{5^2} = \frac{1}{25}$

$\log_7 \left(\frac{1}{343}\right) = -3$

Because $7^{-3} = \frac{1}{7^3} = \frac{1}{343}$

7. Determine the value for each of the following logarithms. Each of these will have non-integer, fractional answers. (Difficult)

(a) $\log_4 2$

(b) $\log_4 8$

(c) $\log_5 \sqrt[3]{5}$

(d) $\log_2 \sqrt[5]{4}$

$\log_4 2 = \frac{1}{2}$

Because $4^{1/2} = \sqrt{4} = 2$

$\log_4 8 = \frac{3}{2}$

Because $4^{3/2} = (\sqrt{4})^3 = 8$

$\log_5 \sqrt[3]{5} = \frac{1}{3}$

Because $5^{1/3} = \sqrt[3]{5}$

$\log_2 \sqrt[5]{4} = \frac{2}{5}$

Because $2^{2/5} = \sqrt[5]{2^2} = \sqrt[5]{4}$

EXPONENT AND LOGARITHM LAWS

LAW	EXPONENT VERSION	LOGARITHM VERSION
Product	$b^x \cdot b^y = b^{x+y}$	$\log_b(x \cdot y) = \log_b x + \log_b y$
Quotient	$\frac{b^x}{b^y} = b^{x-y}$	$\log_b\left(\frac{x}{y}\right) = \log_b x - \log_b y$
Power	$(b^x)^y = b^{x \cdot y}$	$\log_b(x^y) = y \cdot \log_b x$

Exercise #1: Which of the following is equal to $\log_3(9x)$?

(1) $\log_3 2 + \log_3 x$

(3) $2 + \log_3 x$

(2) $2\log_3 x$

(4) $x + \log_3 2$

$$\log_3 9 + \log_3 x$$

$$2 + \log_3 x$$

Exercise #2: The expression $\log\left(\frac{x^2}{1000}\right)$ can be written in equivalent form as

(1) $2\log x - 3$

(3) $2\log x - 6$

(2) $\log 2x - 3$

(4) $\log 2x - 6$

$$\log_{10} x^2 - \log_{10} 1000$$

$$2\log x - 3$$

$$2\log x - 3$$

Exercise #3: If $a = \log 3$ and $b = \log 2$ then which of the following correctly expresses the value of $\log 12$ in terms of a and b ?

(1) $a^2 + b$

(3) $2a + b$

(2) $a + b^2$

(4) $a + 2b$

$$\log(3 \cdot 2^2)$$

$$\log 3 + \log 2^2$$

$$\log 3 + 2\log 2$$

$$a + 2b$$

Exercise #4: Which of the following is equivalent to $\log_2\left(\frac{\sqrt{x}}{y^5}\right)$?

(1) $\sqrt{\log_2 x} - 5\log_2 y$

(3) $\frac{1}{2}\log_2 x - 5\log_2 y$

(2) $2\log_2 x + 5\log_2 y$

(4) $2\log_2 x - 5\log_2 y$

$$\log_2 \sqrt{x} - \log_2 y^5$$

$$\log_2 x^{1/2} - 5\log_2 y$$

$$\frac{1}{2}\log_2 x - 5\log_2 y$$

$$\sqrt{x} = x^{1/2}$$

$$\sqrt[3]{x^5} = x^{5/3}$$

Exercise #5: The value of $\log_3 \left(\frac{\sqrt{5}}{27} \right)$ is equal to

(1) $\frac{\log_3 5 - 6}{2}$

(2) $2 \log_3 5 + 3$

(3) $\frac{\log_3 5 - 3}{2}$

(4) $2 \log_3 5 - 3$

Handwritten work for Exercise #5:

$$\log_3 \sqrt{5} - \log_3 27$$

$$\log_3 5^{\frac{1}{2}} - \log_3 27$$

$$\frac{1}{2} \log_3 5 - 3$$

Common denominator

$$\frac{\log_3 5}{2} - 3 = \frac{\log_3 5}{2} - \frac{6}{2}$$

$$\frac{\log_3 5 - 6}{2}$$

Exercise #6: If $f(x) = \log(x)$ and $g(x) = 100x^3$ then $f(g(x)) =$

(1) $100 \log x$

(3) $300 \log x$

(2) $6 + \log x$

(4) $2 + 3 \log x$

Exercise #7: The logarithmic expression $\log_2 \sqrt{32x^7}$ can be rewritten as

(1) $\sqrt{\log_2 35x}$

(3) $\sqrt{5 + 7 \log_2 x}$

(2) $\frac{5 + 7 \log_2 x}{2}$

(4) $\frac{35 + \log_2 x}{2}$

Exercise #8: If $\log 7 = k$ then $\log(4900)$ can be written in terms of k as

(1) $2(k+1)$

(3) $2(k-3)$

(2) $2k-1$

(4) $2k+1$

Exercise #9: Consider the expression $\log_2(8^x)$.

- (a) Using the third logarithm law (the Product Law), rewrite this as equivalent product and simplify.
- (b) Test the equivalency of these two expressions for $x = 0, 1,$ and 2 .

(c) Show that $\log_2(8^x) = 3x$ by rewriting 8 as 2^3 .